

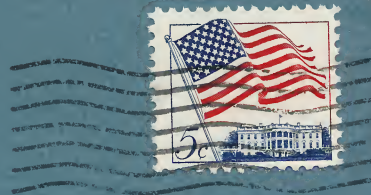
FIFTH IN A COLLECTION OF REALISTIC APPRAISALS
OF THE MAGNETIC RECORDING BUSINESS... by

FERRROXCUBE

CORPORATION OF AMERICA

SAUGERTIES, NEW YORK

**WHAT'S THE TRUE COST
OF A RECORDING HEAD???**



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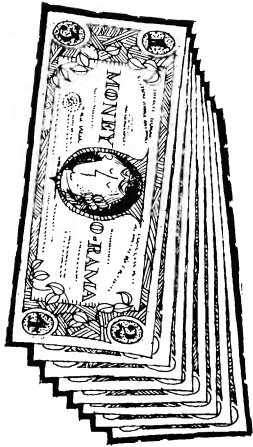
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If the dollar sign is really, as some say, "the most important symbol in Engineering", this fifth monograph should be the one that moves you most of all.

What about it—don't Ferroxcube's all-glass-bonded recording heads deserve an audience? We want to sit opposite you, and talk facts and figures. Come on out and debate, like a man!

As for the dollar sign . . .

WHAT'S THE TRUE COST OF A RECORDING HEAD???



— From cradle to grave, we mean; including initial cost, installation, preventive maintenance, preventive replacement, “involuntary” repair and replacement, and the indirect cost of shutting down long enough to perform that maintenance, replacement, or repair.

Actually, it is necessary to start the cost calculation *before* the cradle — in the system design phase — and ask ourselves whether the system cost is not significantly affected by the characteristics of the recording head.

After all, the purpose of all such systems is to record a certain number of bits in a certain period of time and in a certain amount of space. If the **cost per bit** of a system is 10% higher, because the recording head limits the bit density or track spacing. . . then the system designer simply **cannot afford** that recording head, regardless of its price. If he knows his business, you couldn't **give** him that head, as a gift!

Circumstances vary widely, but in the great majority of installations, the use of a Ferroxcube all-glass-bonded recording head saves more than the initial cost of the head. . . in **other words**, the **Ferroxcube** head is not only the best, it is actually the least expensive!

There's nothing very tricky about the calculation. Your numbers may not agree with ours, but your conclusions will, when you check the arithmetic.

LET'S BEGIN AT THE END — THE "IN-SERVICE"
PERFORMANCE OF THE HEAD:

- How often must the head be replaced?
- What does it cost to replace it?
- How often must the head be inspected, to insure against premature failures?
- How often must the head be removed for cleaning or recrowning?
- How long does it take to reinstall, realign, and test the read/write assembly?
- How much more competitive would the entire system be, if all of the above maintenance and repair burdens were significantly reduced ???

NEXT, LET'S TURN OUR ATTENTION TO THE
INTERACTION OF THE HEAD CHARACTERISTICS
AND THE EQUIPMENT DESIGN . . .

- Will higher electromagnetic performance reduce the burden on the electronics of the system?
- Will better uniformity, achieved through greater dimensional control and stability, reduce the cost and complexity of the system mechanics?
- Will the above factors improve the operating margins, at the end of the recommended maintenance cycle, so that less margin is required in the rest of the equipment, reducing the cost?
- How much more could you charge for the equipment if it had state-of-the-art performance characteristics?

**COST OF MAINTAINING SATISFACTORY RECORDING-HEAD
PERFORMANCE FOR FIVE YEARS IN A 7-TRACK DIGITAL TAPE TRANSPORT**

COST ELEMENT	COST FOR ⁽¹⁾ 5 YEARS		EQUIVALENT ⁽²⁾ COST/YEAR		EQUIVALENT ⁽²⁾ COST/1000 HRS	
	CONVENTIONAL HEAD (3)	FCOA HEAD (4)	CONVENTIONAL HEAD (3)	FCOA HEAD (4)	CONVENTIONAL HEAD (3)	FCOA HEAD (4)
Initial Cost of Heads (3 and 4)	\$3,000	\$ 900	\$ 600	\$180	\$150	\$ 45
Cost of Cleaning and Inspection (3 and 4)	1,200	400	240	80	60	20
Cost of removal for recrowning and reinstallation (5)	800	—	160	—	40	—
Cost of replacement (installation and test)	600	120	120	24	30	6
Cost of scheduled shut-downs (6)	3,000	617	600	124	150	31
Cost of unscheduled shut-downs (7)	800	266	160	53	40	13
TOTALS	\$9,400	\$2,303	\$1,880	\$461	\$470	\$115

(1) Assuming the conditions stated in each of the notes below.

(2) Assuming uniform usage (4,000 hours/year, on 3 shifts, at 60 ips) and averaging all costs over full 5 years.

(3) Conventional heads (at \$300. each) assumed to have 2,000 hour life, requiring cleaning and inspection every 500 hours.

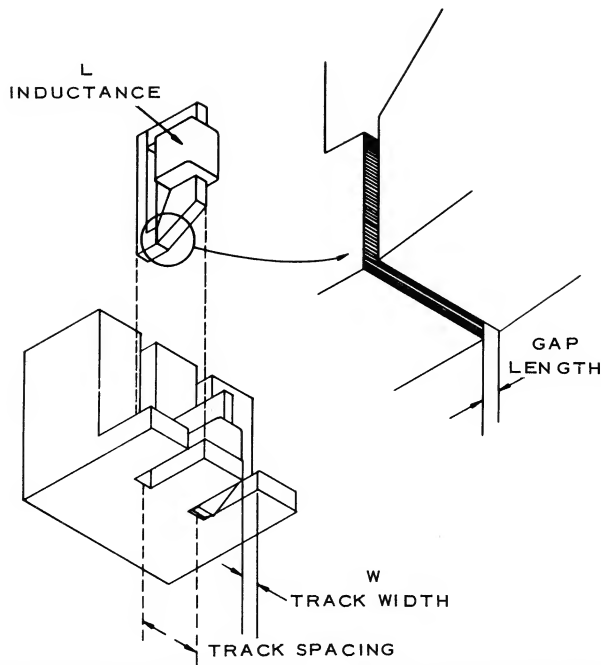
(4) Ferroxcube heads (at \$450. each) assumed to have 10,000 hour life (since we have not completed our tests, and cannot verify that life is actually much longer, as noted earlier) requiring cleaning inspection every 1,500 hours.

(5) Conventional head must be removed for recrowning every 1,000 hours.

(6) Computed for an "average" EDP system, assuming a spare transport is available, and estimating system down-time cost at \$10/minute.

(7) Computed at rates described in (6), for 1 unscheduled failure per 10 maintenance cycles.

In summary, the five-year savings created by the choice of a Ferroxcube All-Glass-Bonded head for this tape transport, in this application, were over \$7,000 — more than 15 times the original cost of the head, and more than 45 times the cost difference between the Ferroxcube head and a conventional head!



HERE ARE THE FUNDAMENTAL

Fundamental Dimensional Relationships.

The drawing to the left indicates the fundamental dimensions that determine the performance—and, hence, the design — of a “flying head”. Note that the relationships between these critical dimensions and the head performance are given by

$$\text{Read-out voltage} = k_1 n W$$

where n = number of turns per winding

and W = track width

$$\text{Inductance } L = k_2 n W v$$

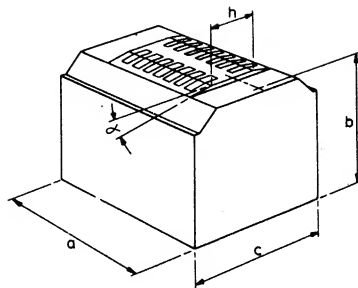
where v = velocity

$$\text{Drive } i \approx \frac{K_3 H}{n}$$

TECHNICAL RELATIONSHIPS INVOLVED...

Read-To-Write Relationships.

As illustrated here, certain dimensions and tolerances must be applied to multiple-head assemblies in which the read/write function is provided — whether in a unit assembly, or in a pair of assemblies. Note that this set of specifications is actually derived from the basic data format planned for the system.



Head-To-Head Dimensional Relationships.

Equally as important as the fundamental head-to-medium relationships are the dimensions and tolerances that relate one head to another in a multi-head assembly. These include: head *spacing* (distance between gap centerlines); head *separation* (distance between facing magnetic surfaces of adjacent cores); track width; gap length; and, of course, at least an estimate of gap alignment requirements.

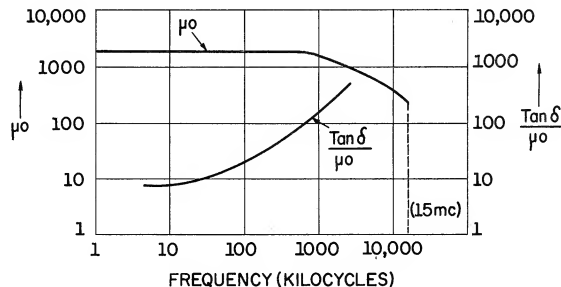
HERE'S HOW FERROXCUBE ALL-GLASS-BONDED RECORDING HEADS ARE DESIGNED AND MANUFACTURED...

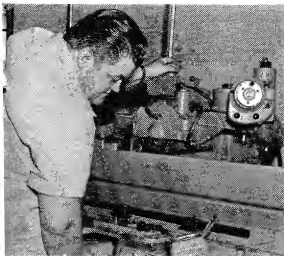
THE DESIGN may begin in either of two ways:

- You may prepare a complete electrical, magnetic, and mechanical specification, and then have us provide an equivalent all-glass-bonded design.
- You may merely state the head-to-medium spatial relationships, specify the limiting electromagnetic properties of the medium, and describe the input-output signals and interfaces. . . and let us write an equivalent specification.

FERROXCUBE 4R5 is the core material used in all-glass-bonded recording heads. It is unique in having chemical, thermal, and mechanical characteristics that are fully compatible with the special glass used to bond the head assembly; this unique formulation sacrifices very little in either its electrical or magnetic properties to achieve that compatibility, as the graph shows. These parameters are very accurately controlled.

**ALL-GLASS-BONDED
HEADS ARE MADE BY
A HIGHLY-DEVELOPED
FIVE-STEP PROCESS**



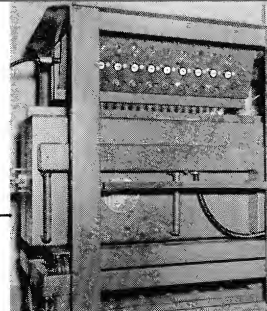


Precision Core Grinding . . . Ferroxcube ferrite facilities are unequalled anywhere in the world.

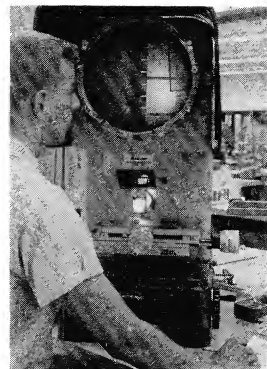
Precision Winding . . . Ferroxcube's modern winding facility employs the most modern fine-wire winding features and techniques currently available.



Quality-Assured Precision Assembly . . . Ferroxcube's new assembly line operates under the most rigid quality controls in the industry—from the ultimate security of 100% in-plant manufacture of all critical elements to the maintenance of "white-room" environments for all critical assembly operations.



Unique Glass Bonding Facility . . . Ferroxcube's all glass-bonding technique is an exclusive process.



Micro-Finish and Testing . . . Ferroxcube has developed completely new micro-finishing techniques compatible with the new higher dimensional - control standards made possible by all-glass bonding, and testing techniques, compatible with the 1.7 microinch RMS surface finish achieved on all standard heads.

IN SUMMARY, THEN, WE MAY SAY

that the specific advantages of Ferroxcube All-Glass-Bonded Recording Heads which make them the lowest-true-cost heads for *any* application are:

- highest achievable bit-density:
 - per track
 - per linear inch
 - per square inch
 - per *dollar* of equipment investment
- longest life, hence:
 - lowest replacement cost per year
 - lowest routine maintenance cost per year
 - lowest incidence of unscheduled shutdowns
 - least stress on equipment margins

(therefore, longest MTBF of associated electronics)

...IN FACT, THE FERROXCUBE HEAD IS THE MOST ECONOMICAL PATH TO HIGHER PERFORMANCE.



**THESE
EXAMPLES
WILL SERVE
TO ILLUSTRATE
THE RANGE
& VARIETY
OF HEADS
WE NOW
MANUFACTURE...**

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FERROXCUBE

CORPORATION OF AMERICA

SAUGERTIES, NEW YORK

**ATTENTION
RECORDING-HEAD
APPLICATION ENGINEERING
DEPARTMENT**

Gentlemen:

I read you, loud and clear, and here's my reaction:

- ☐ I believe you have reached my boiling point—have one of your application engineering group call me for an appointment, before I build up excessive pressure.
- ☐ I'm thawing. Send over one of your fire-breathing field engineers. (Have him call for an appointment, first.)
- ☐ I'm far from convinced—hardly warm, in fact—but I can't afford to ignore all-glass-bonding any longer. Send me your brochure, and any other fuel you wish to throw on the fire.

☐ Here's my Name _____ and Title _____
my Company _____
and Division _____
Street Address _____
City, State, Zip _____

☐ You're talking to the wrong party. Try your pitch on:

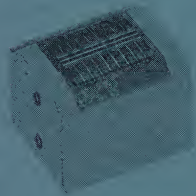
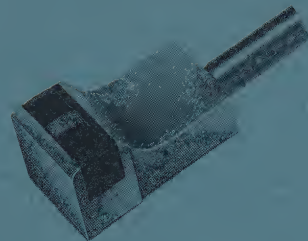
Name _____ Title _____

☐ At the Above Address or ☐ At: _____



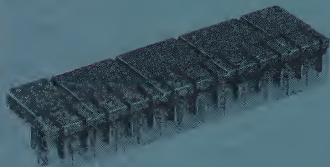
◀ 7-Channel Read-Write
Contact Analog Tape
Head.

Digital Contact Head for a
"Magnetic-Stripe-Reader"
Used in Business-Machine
Applications. ▶

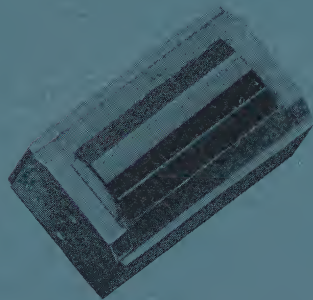


◀ 7-Track Digital Head. The
standard final finish is held
to 1.7 microinches, RMS,
and this finish is main-
tained to within 2 micro-
inches over thousands of
hours of use.

8-Track Analog Head for
a Tape Transport. ▶



◀ 13-Unit Assembly of Flying
Disc File Head.



**HOW
ABOUT
YOUR
MAGNETIC
RECORDING
SYSTEMS?
ISN'T IT
TIME WE
PUT OUR
HEADS
TOGETHER...?**